

41. (New) The semiconductor device according to claim 30 wherein the semiconductor film of the second thin film transistor comprises a metal selected from the group consisting of nickel, iron, cobalt, and platinum.

42. (New) The semiconductor device according to claim 33 wherein the first semiconductor film further comprises a metal selected from the group consisting of nickel, iron, cobalt, and platinum.

43. (New) The semiconductor device according to claim 36 wherein the first semiconductor film further comprises a metal selected from the group consisting of nickel, iron, cobalt, and platinum.

REMARKS

We are in receipt of the Office Action dated July 19, 2001, and the above Amendments and following remarks are made in light thereof.

Claims 1-15 and 30-38 are pending in this application. Pursuant to the present Amendment, claims 3, 6, 9, 12 and 15 are canceled and new claims 39-43 are added.

In the Office Action, claims 30-38 stand rejected under 35 U.S.C. 112, first paragraph (written description and enablement); claims 1, 4, 7, 10, 13, 31, 34 and 37 stand rejected under 35 U.S.C. 112, second paragraph (indefiniteness) and claims 1-15 and 30-38 stand rejected under 35 U.S.C. 103 for obviousness.

By way of the foregoing amendments, claims 3, 6, 9, 12 and 15 have been canceled. Thus, the various rejections for obviousness in connection with these claims is rendered moot. The remaining claims 1, 2, 4, 5, 7, 8, 10, 11, 13, 14 and 30-38 stand rejected for obviousness over Zhang '733 in combination with King, or in combination with King and Zhang '277.

The present invention is directed to a semiconductor device such as an active matrix display device having at least two thin film transistors. In accordance with a typical example of the present invention, a pixel TFT connected to a pixel electrode has a channel region comprising silicon which is not doped with germanium while a TFT included in a driver circuit for driving the pixel TFT has a channel region comprising silicon which is doped with germanium. The TFT having a channel region comprising silicon doped with germanium is suitable for realizing a high field effect mobility. However, the applicant recognized a problem that such a TFT tends to have a higher off current due to the large carrier density. Based on the recognition of this problem, the applicant's invention resides in the use of the TFT having a channel region comprising silicon doped with germanium in a selected portion of the semiconductor device depending upon the required characteristics of the circuits.

The Examiner asserts that "the difference between Zhang et al. (see the entire patent enclosed) and the set of rejected claims is their complementary driver circuit transistors are formed in polycrystalline silicon and polycrystalline silicon germanium, respectively." The Examiner concludes that "[i]t would have been obvious to one skilled in this art to advantageously form Zhang et al's complementary driver circuit transistors (but not its pixel circuit transistors, which Zhang et al. disclose are on a different design footing than the driver circuit transistors), in polycrystalline silicon-germanium rather than polycrystalline silicon, as taught by King et al."

Zhang '733 teaches the selective addition of nickel, iron, cobalt or platinum (column 2, lines 43-45) for promoting crystallization and a driver circuit TFT, while such a metal is not intentionally used in a pixel TFT. In addition, King et al. teach polycrystalline silicon-

germanium thin film transistors. Thus, it appears that the examiner contends that it would have been obvious to utilize the polycrystalline silicon-germanium thin film transistors of King et al. for the driver TFTs of Zhang '733 to achieve the devices recited in the rejected claims.

Applicant respectfully disagrees with the Examiner's conclusions. Zhang '733 does not teach that germanium can be used as the catalyst. King et al. merely teaches to form a Si-Ge film and crystalize it. There is no suggestion or motivation to combined these references in the manner suggested by the Examiner. Zhang '277 does nothing to overcome the deficiencies of Zhang '733 and King et al. Accordingly, applicant respectfully requests that the Examiner reconsider and withdraw his rejection based on the prior art.

Claim 1 has been amended to address the indefiniteness rejection. New claims 39-43 are dependent claims and, therefore, should be allowable for the same reasons as set forth above.

Accordingly, applicant respectfully submits that the present application is in condition for allowance, and an early Office Action in this regard is earnestly solicited.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

1: (Twice Amended) A semiconductor device comprising:

a substrate;

a first thin film transistor having a first active layer comprising $\text{Si}_{1-x}\text{Ge}_x$ where $0 < X < 1$

formed over said substrate; and

a second thin film transistor having a second active layer comprising silicon formed over

said substrate wherein said second active layer is not intentionally [doped] added with

germanium.

30. (Amended) A semiconductor device having an active matrix type display device, said display device comprising:

a substrate having an insulating surface;

a plurality of pixel electrodes arranged in a matrix formed over said substrate;

a plurality of first thin film transistors for switching said pixel electrodes and formed over said substrate;

a driver circuit formed over said substrate for driving said plurality of first thin film transistors, said driver circuit comprising at least one second thin film transistor;

each of said first thin film transistors and said second thin film transistor comprising:

a semiconductor film comprising silicon and including at least one channel region;

a gate insulating film adjacent to said channel region; and

a gate electrode adjacent to said gate insulating film;

wherein the semiconductor film of said second thin film transistor contains germanium at a higher concentration than the semiconductor film of said first thin film transistors and the semiconductor film of the first thin film transistors is not intentionally added with germanium.

31. (Amended) The semiconductor device according to claim 30 wherein the semiconductor film of said plurality of first thin film transistors is not [doped] added with germanium while the semiconductor film of said second thin film transistor is [doped] added with germanium.

33. (Amended) A semiconductor device comprising:

a substrate having an insulating surface;

a first thin film transistor formed over said substrate, said first thin film transistor comprising:

a first semiconductor film comprising crystalline silicon formed over said substrate and having a channel region;

a first gate insulating film adjacent to said first semiconductor film; and

a first gate electrode adjacent to said first gate insulating film;

a second thin film transistor formed over said substrate, said second thin film transistor comprising:

a second semiconductor film comprising crystalline silicon formed over said substrate and having a channel region;

a second gate insulating film adjacent to said second semiconductor film; and

a second gate electrode adjacent to said second gate insulating film,

wherein said first semiconductor film contains germanium at a higher concentration than said second semiconductor film and the second semiconductor film is not intentionally added with germanium.

34. (Amended) The semiconductor device according to claim 33 wherein said first semiconductor film is [doped] added with germanium while the second semiconductor film is not intentionally [doped] added with germanium.

36. (Amended) A semiconductor device comprising:

a substrate having an insulating surface;

a first thin film transistor formed over said substrate, said first thin film transistor comprising:

a first semiconductor film comprising crystalline silicon formed over said substrate and having a channel region;

a first gate insulating film adjacent to said first semiconductor film; and

a first gate electrode adjacent to said first gate insulating film;

a second thin film transistor formed over said substrate, said second thin film transistor comprising:

a second semiconductor film comprising amorphous silicon formed over said substrate and having a channel region;

a second gate insulating film adjacent to said second semiconductor film; and

a second gate electrode adjacent to said second gate insulating film,

wherein said first semiconductor film contains germanium at a higher concentration than said second semiconductor film and the second semiconductor film is not intentionally added with germanium.

37. (Amended) The semiconductor device according to claim 36 wherein said first semiconductor film is [doped] added with germanium while the second semiconductor film is not intentionally [doped] added with germanium.